

# EuroEAP Society Challenge 2021

## FINAL SUBMISSION FORM

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**Title of the demo/project:**

An off-the shelf High Voltage Signal Generator

**Name of the team leader and his/her affiliation:**

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**Description of the final demo**

Industry adoption of EAP technology is challenged by the negative perception of high voltages, and there are no cost-effective or simple solutions in the market for multi-waveform voltage generation targeted for EAP control, which limits the translation of laboratory EAP to products. PowerON offers an easy to use, off-the-shelf benchtop equipment – the High Voltage Signal Generator, which possesses 4 independent HV channels, outputs up to 4kV per channel with various waveform choices and phase shift capability – to help engineers in both industry and research to develop, test, and operate EAP devices. Often power requirements are considered secondary to an EAP demonstration, but the operating signals are vital for the EAP device, and the HVSG was designed with engineers in mind to fill this gap in research and provide a solution for industrial applications.

Our demonstrator video showcases the use and control of the HVSG via the touch-screen user interface and the application of the device in everyday lab work by a PhD student. A more detailed description of the HVSG can be found in the attached datasheet.

# High Voltage Signal Generator

## Features

- 4 high voltage output channels
- High voltage output of 0 to 4kV
- Output source current of 0.5mA
- DC, rectangle, triangle, and sinusoidal output waveform generation
- Frequency operation of up to 10Hz
- Variable waveform phase delay selection



## Description

The High Voltage Signal Generator (HVSG) is a laboratory bench-top equipment which has 4 independent high voltage (HV) channels. Each output channel runs up to 4kV, 0.5mA and generates signal waveforms of up to 10Hz and down to fractional Hz. Users can perform multi-phase experiments by selecting the phase delay between channels. Each HV channel output has short circuit protection for safety.

The HVSG comes with a highly responsive 7" capacitive touch screen display for good clarity and ease of use. Graphical representation of the waveforms, which are based on users' settings, is shown to provide quick reference check. Users can save their desired settings within the HVSG and load the stored settings when desired.

## Applications

- Dielectric elastomers
- Capacitive charging
- Ignition/Spark
- Mass spectrometry
- Electrophoresis
- Sustaining Ion Pumps

## Specifications

| Parameter                        | Conditions                        | Min  | Typ | Max | Unit |
|----------------------------------|-----------------------------------|------|-----|-----|------|
| <b>High voltage outputs</b>      |                                   |      |     |     |      |
| Channels                         |                                   |      | 4   |     |      |
| Output voltage                   |                                   | 0    |     | 4.1 | kV   |
| Output source current            |                                   |      | 0.5 |     | mA   |
| Output sink current              |                                   |      | 0.6 |     | mA   |
| Output voltage accuracy          | 0.2kV to 4kV output               |      | ±3  |     | %    |
| Programmable output delay        |                                   |      |     | 10  | s    |
| Output capacitance               |                                   |      | 470 |     | pF   |
| HV connector insulation          |                                   |      | 13  |     | kV   |
| <b>DC waveform output</b>        |                                   |      |     |     |      |
| Rise time                        | No load                           |      | 13  |     | ms   |
|                                  | Rated load                        |      | 22  |     | ms   |
| Overshoot                        | No load                           |      | 0.5 | 1   | %    |
|                                  | Rated load                        |      | 0.5 | 1   | %    |
| Ripple                           |                                   |      | 10  | 15  | V    |
| Channel delay                    |                                   | 0    |     | 5   | s    |
| <b>Rectangle waveform output</b> |                                   |      |     |     |      |
| Frequency, $f$                   |                                   | 0.01 |     | 10  | Hz   |
| Duty cycle                       | $f \leq 1\text{Hz}$               | 5    |     | 95  | %    |
|                                  | $1\text{Hz} < f \leq 3\text{Hz}$  | 10   |     | 90  | %    |
|                                  | $3\text{Hz} < f \leq 5\text{Hz}$  | 20   |     | 80  | %    |
|                                  | $5\text{Hz} < f \leq 10\text{Hz}$ | 30   |     | 70  | %    |

| Parameter                       | Conditions                             | Min | Typ  | Max  | Unit |
|---------------------------------|--|-----|------|------|------|
| Rise time                       | No load                                |     | 11   |      | ms   |
|                                 | Rated load                             |     | 15   |      | ms   |
| Fall time                       | No load                                |     | 11   |      | ms   |
|                                 | Rated load                             |     | 11   |      | ms   |
| Overshoot                       |  |     | 0.5  | 1    | %    |
| Phase delay                     |  | 0   |      | 360  | °    |
| <b>Triangle waveform output</b> |  |     |      |      |      |
| Frequency, $f$                  |  | 0.1 |      | 10   | Hz   |
| Symmetry                        | $f \leq 2\text{Hz}$                    | 5   |      | 95   | %    |
|                                 | $2\text{Hz} < f \leq 3\text{Hz}$       | 10  |      | 90   | %    |
|                                 | $3\text{Hz} < f \leq 5\text{Hz}$       | 15  |      | 85   | %    |
|                                 | $5\text{Hz} < f \leq 10\text{Hz}$      | 20  |      | 80   | %    |
| Phase delay                     |  | 0   |      | 360  | °    |
| <b>Sine waveform output</b>     |  |     |      |      |      |
| Frequency, $f$                  |  | 0.1 |      | 10   | Hz   |
| Total harmonic distortion       | $0.1\text{Hz} \leq f \leq 10\text{Hz}$ |     |      | 1.5  | %    |
| Phase delay                     |  | 0   |      | 360  | °    |
| <b>Input mains supply</b>       |  |     |      |      |      |
| Input voltage                   |  | 100 |      | 240  | V    |
| Frequency                       |  | 47  |      | 63   | Hz   |
| Input power                     |  |     |      | 35   | W    |
| Quiescent current               | 120VAC input                           |     | 0.25 |      | A    |
|                                 | 230VAC input                           |     | 0.23 |      | A    |
| Input current                   | 120VAC input, rated load               |     | 0.4  |      | A    |
|                                 | 230VAC input, rated load               |     | 0.3  |      | A    |
| Inrush current                  | Cold start, 115VAC input               |     |      | 25   | A    |
|                                 | Cold start, 230VAC input               |     |      | 45   | A    |
| <b>Environmental</b>            |  |     |      |      |      |
| Operating temperature           |  | 15  |      | 35   | °C   |
| Operating environment           | Indoor location                        |     |      |      |      |
| Storage temperature             |  | 0   |      | 40   | °C   |
| Altitude                        |  |     |      | 2000 | M    |
| Humidity                        | Non-condensing                         | 0   |      | 80   | %    |
| <b>Mechanical</b>               |  |     |      |      |      |
| Width                           |  |     | 320  |      | mm   |
| Depth                           |  |     | 287  |      | mm   |
| Height                          | Tilt legs not extended                 |     | 161  |      | mm   |
|                                 | Tilt legs extended                     |     | 196  |      | mm   |
| Weight                          |  |     | 5    |      | kg   |

All specifications are based on operation at 23°C unless specified otherwise. The rated load condition is HV output operation with  $9\text{M}\Omega$  load at each HV channel.

**Link to download a video file of the demo.**

<https://cloud.poweron.one/s/FQbfFEpewA5m9fk>

**SIGNATURE OF THE TEAM LEADER**

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**SUBMISSION**

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